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# THE EFFICIENT USE OF FUELS

By C. C. ONYEMELUKWE,
B. Sc. (Eng), B. Sc. (Econ.), A. M. I. E. E.,
A. M. I. Mech. E., A. M. B. I. M., A. M. Inst. F.,
Chief Electrical Engineer,
Electricity Corporation of Nigeria

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Paper - 'The Efficient Use of Fuels'

By

Mr. C.C. Onyemelukwe, B.Sc(Eng), B.Sc(Econ), A.M.I.E.E, A.M.I.Mech.E, A.M.B.I.M, A.M.Inst.F, Chief Electrical Engineer
Electricity Corporation of Nigeria

1. One striking feature of the fuel supplies of the under-developed countries is the striking variation in the available fuel resources from one country to another. For while countries like those in the Middle East have abundant supplies, others like some of the new nations in Africa have little potential reserves. Yet all these countries are geared to a programme of eventual large scale industrialization.

2. In contrast with the more developed countries, it is well known that one of the reasons adduced for the start of industrialization in some of these countries is abundant fuel supplies. Examples are countries like Britain, U.S.A. and Germany where coal mining provided employment opportunities and was responsible for the growth of steam locomotive and other dependent industries. The question that causes concern is whether in those developing countries with shortage of adequate sources of power the chances of their getting to the stage of a "take-off" in their economic growth will be hampered as a result. If so can these countries do anything to mitigate the effects of shortage of energy.

Lack of Attention to Efficient Use of Fuel

3. In the circumstance, one would have expected that developing countries with small reserves will at least pay great and urgent attention to the problems of efficient use of fuel. This in fact does not seem to be the case and not too surprisingly, this is also the situation in those with abundant supplies. There are a number of reasons for this.

4. Firstly, fuel technology has only recently - in fact only over the last two decades - received serious study on a national and international basis. This sudden break through in fuel technology may be accounted for by the growing alarm about the so-called "energy-gap" which seems to be rearing its head especially in the Western European countries and the fact that progress in atomic energy as an alternative means of fuel supply has not fulfilled all the hopes placed on it. Furthermore, the growing international competition in trade has forced countries to investigate all means of strengthening their competitive position. Fuel economy has therefore become very topical. This sudden uplift in the level of fuel technology will naturally take time to have an equivalent impact in the under-developed countries. Besides it seems proper to claim that attention seems rightly or wrongly to be directed in the developing countries to getting the industries first and then later studying means of improving their efficiency. The art

of making fire dates from time immemorial and it is not surprising that in the absence of any major technical advance in the science of fuel, crude methods of fuel utilisation have persisted in the face of little or no national awareness of the contributions of fuel economy to economic growth. Another contributory factor is the increasing popularity of hydro resources among many of the new nations, sometimes even for prestige purposes. Initially the available capacity of such hydro resources is enough to reduce the demand for fuels to a point where the need for economy in fuel utilisation becomes neglected.

## PROBLEMS OF FUEL EFFICIENCY

5. The wider problem of efficient use of fuel embraces four broad aspects. The first is a close study on a national scale of the pattern of the growth of the economy. The second is again another study this time of the changing pattern of demand especially in the switch from one type of fuel to another. The third which is all-embracing is the establishment of reliable data of comparative costs and manpower requirements of different fuel and energy industries existing in the economy. Where fuel is imported, the equivalent data for the imported fuel must also be established. The fourth is to create a national conscience for fuel economy and efficiency.

### Growth of the Economy

6. It is true to remark that one of the greatest problems of planning in a developing country is the lack of accurate information on which planning can be based. Fuel and power industries are no exception to this. Data on industrial growth, if centrally collected, will be of immense benefit to national energy planning. It must be borne in mind that the fuel and power are very high capital consuming industries and therefore their activities today are based on plans made three, four, five or more years. It will therefore make a great difference to their scale of operations whether the economy is likely to develop in the chief fuel-using industries like brick, ceramics, cement, iron and steel, textiles or in the light fuel-consuming industries like paper, radio engineering. It must be borne in mind that the capital investment in industry which utilizes a given amount of energy is much greater than that in the plants for producing this amount of energy. If therefore such energy is not available a much greater investment would be rendered idle than if there was excess of power by a similar amount. It is therefore evident that failure of the fuel and power industries to plan adequately due to lack of accurate information on the growth of the economy can only be blamed on the country.

7. The relationships between the various types of energy sources in the demand for them by consumers are so complicated whilst the various influences concerned are so multilateral that it is insufficient for each energy authority to compute its own statistics independently. For in doing so, the nation loses sight of the various inter-relationships which are very useful for national planning. It would therefore be of great value if existing national statistics were combined into a comparable format showing the use of all forms of energy in each sector of the economy and the relations between these and economic growth.

## Changing Pattern of Demand

8. The demand for fuel, like many other commodities, keeps changing in the face of changing tastes and the appearance of alternatives. The two main causes of changes in fuel demand are technological and economic. In the industrial field, the developing countries will probably expect a large slice of their demand for energy to come from the establishment of new heavy industries. In the developed countries, on the other hand, it is known that the growth in demand is becoming less intensive in the industrial and commercial use of energy whilst the low energy using services form a higher proportion of the gross national product*. In the domestic field, space heating loads are bound to play a greater part in the energy demand in the developed countries. The under-developed countries, on the other hand, many of whom are in the tropical or sub-tropical zones will expect a gradual increase in the development of "comfort cooling" in which air conditioning is bound to play a prominent part. The use of air conditioners however is bound to be given a low priority in the social development as its income elasticity is very low until well above the subsistence level of income.

9. Apart from development of new loads, there is the customary switch in every sector from one form of fuel to another, the most familiar example of which in many countries is the switch from steam locomotives to diesel locomotives. As between coal, oil, gas, atomic energy and hydro-power in any economy, the relative change in the pattern of demand provides useful basis for study and brings into prominence the question whether to allow for free competition or whether in view of other external factors to subsidise directly or indirectly one fuel as against another.

## Comparative Cost and Manpower Requirements

10. Much of the confusion that arises in developing a consistent attitude to the topic of fuel supply in many countries is due to the lack of comparative data on cost and manpower requirements of the various fuels. It is true that the cost includes elements of the cost of labour. The need to know the comparative manpower requirements is because the question of which fuel to use has wide social significance and touches seriously on the common problem of unemployment in the developing countries. In other words, whatever economic gains may be made by changing from one fuel to another must be balanced against the social aspects in so far as they affect employment. To obtain these comparative data can be done very fruitfully more on a national basis.

## Economy and Efficiency

11. Increasing industrialization requires sustained supply of different types of fuels for basic conversion into heat and power. In the actual production of power, the aim should be to convert the heat units in the fuel to a usable form with minimum loss, that is at a high thermal efficiency. Where the processis the conversion of the fuel into a different form of energy, heat is usually required as a medium. Here again the aim is to apply heat with minimum loss from

* "Factors Affecting the Future Pattern of World Energy Market" by M.G. Graham W.P.C. 1962.

the system. High efficiency is again the criterion. Fuel efficiency is therefore basic to industrial processes.

12. A recent survey was carried out in one country showing firms in one and the same industry together with their fuel consumption. This was expressed as a percentage of the weight of fuel consumed to the weight of goods produced. In the one group, one firm consumed 20 percent whilst at the other end of the scale another consumed 200 percent. In other words, the second firm was using ten times as much fuel as another per unit of product. It is admitted that no two firms in the same industry have identical conditions of production. But such differences are too wide to be accounted for wholly by the non-identical conditions obtaining in the firms. With such bad performance how can the least efficient firms hope to compete easily with the most efficient, how much less with those of other countries in the world market?

Practical Aspects of Fuel Efficiency

13. In an attempt to exercise economy and attain high efficiency of use, fuel technology has moved a long way. One of the most outstanding branches where this is the case is in the field of low grade utilisation. Many countries have dumps of slurry, peat, lignite, high ash and high moisture and fine coal. Such fuels were in the past considered useless. Many new devices and equipments have now been introduced for the production, transport and utilisation of these low grade fuels. In some cases, where the calorific value has been so low as will adversely affect steady ignition, mixing devices have been introduced so as to mix these fuels with high grade fuels before ignition. The greatest field of development for low grade fuels is in the power generation fields where versatility of the boiler is of a great advantage.

14. Another branch of development is that of waste heat recovery. This has shown great potentials in the industrial fields. Knowledge is now becoming more precise about the heat flow and transfer at low temperatures whilst research has continued into conditions at the metal surface under these conditions. All these are already showing heavy financial returns as a result of the fuel economy achieved.

15. Thirdly, outstanding developments have been made in automatic control of combustion. From the pneumatic and hydraulic controls, increasing use of electronic control is being made. The main advantage of this development is that heat transfer can be effected under optimum conditions to suit the requirements of a process, thus eliminating much of the human element which accounts for a lot of losses and inefficiency.

16. Fourthly, there is growing awareness about the contributions of thermal efficiency to total costs of operation. An important aspect of the common features of operation in many installations is the preparation of statistics on thermal efficiency, fuel costs, heat balances etc. Theoretical and empirical formulas together with instruments for checking them are increasingly being devised for gas composition, fuel losses, smoke density etc.

## Recommendations for Increasing Fuel Efficiency in Developing Countries

17. Much must be done by fuel producing industries in developing countries. In many cases, the size of installations in the consumer's premises is so small that he has neither the facility nor the need as such to carry out research into fuel utilisation. The fuel producing industries in these countries stand to gain by conducting research not only in fuel production but also fuel utilisation as these increase the competitiveness of their products nationally and remembering of course that the world fuel market is highly competitive. Where necessary, governments should subsidise part of these researches.

18. Training in fuel technology is seriously lacking in many of the developing countries. This is because the few universities and technical colleges available are devoted to the pressing basic technologies. It is suggested that serious consideration should be given to the establishment of faculties of fuel technology. Alternatively as fuel technology is very much akin to chemistry and physics, these two departments could combine by proper contribution of course lectures to give basic training in fuel technology.

19. Encouragement should be given by fuel producing industries to the private citizens who wish to set up as consultants in fuel technology by putting these people in touch with potential customers. The N.I.F.E.S. of Britain is doing a fine job and its annual reports are a testimony to what the country has gained as a result of fuel efficiency service to industry.

20. Lastly, developing countries must attempt to formulate their national fuel policy. This must be a practical policy taking into account costs, manpower, balance-of-payment etc. The setting up of National Committees of the World Power Conference is urged as a means of helping to formulate this policy. The World Power Conference has as its objects the development and peaceful uses of energy resources to the greatest benefit nationally and internationally. The link between a national committee and the main body ensures that a country has knowledge of the latest development in fuel production and utilisation, and can apply these to develop sound fuel policies for its country. This committee can also by adequate propaganda create national conscience for fuel economy and where necessary advise their respective government about the need for legislative measures.

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